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A Study of Cucurbitaceous Vegetables in the Philippines

By Dionisio R. Tuason

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The plant family Cucurbitaceæ includes about 650 species under 87 genera. Most of the species are found in the tropics and in the warmer parts of the temperate regions. They are rapid-growing vines which climb by means of tendrils, and produce fruits commonly known as pumpkins, squashes, melons, gourds, marrows, citrons, cucumbers, etc., all of which are excellent for use as vegetables and some are good as fruits for dessert. Cucurbitaceous plants are monœcious, having the two sexes on separate flowers but on the same plant. The yield under irrigation in the dry season is better than the yield in the wet season. These plants can be propagated by seeds, but in some cases favor propagation by layering.

Available literature and verbal information have failed to give definite facts as to the introduction of these plants into the Philippines. Native growers generally suppose that some of them were brought into the Islands either by the Spanish or the Chinese, or both, their suppositions being based upon the fact that some of the names of plants are associated with either Spanish or Chinese, as for example, Patolang castila (Spanish luffa), and Pepinong intsik (Chinese cucumber). According to the collection of data on these plants made by W. Ed. Safford, (1) they are found also in Mexico, which was from 1520 to 1821 a Spanish colony, as were the Philippines from 1542 to 1898, so it may be supposed that seeds of these plants were brought from Mexico to this country in the periodical trips of the galleons.

While growers of cucurbitaceous plants in the Philippines know that they can raise them successfully even without cultivation and other care, still, only a few realize the importance of their harvest in supplying the regular market demand. Most of those who raise

cucurbitaceous fruits raise them only for home consumption. Only a few raise them on a commercial scale. The fact that there is always a demand for cucurbitaceous fruits in the Philippine markets throughout the whole year justifies extended study of these particular garden crops.

The present study has been undertaken (a) to determine the yield per unit of area, (b) to determine how the plants behave in different seasons, with a view of estimating the possibilities of supplying the market all the year with fresh fruits, (c) to determine the possibilities of introducing foreign varieties of superior quality.

Growers of these plants in the Philippines believe that they can be planted only during the months of May and June as a rainy season crop and during November and December as a dry season crop.

PRESENT STATE OF CUCURBITACEOUS VEGETABLE INDUSTRY IN THE PHILIPPINES

In Luzon, in some towns of the provinces of Bataan, Batangas, Bulacan, Ilocos Norte, Ilocos Sur, Laguna, Nueva Ecija, Rizal, and in some provinces of the Visayas, and Bukidnon in Mindanao, these vegetables are raised on a comparatively large scale, considering the demand in these localities. Yet the area planted, compared with that planted with the staple crops, is very small. This is explained, not by the lack of good gardeners to handle extensive plantations, for the vegetables are easy to grow, but by their lack of appreciation of their importance in the manufacture of candies, pies, salads and pickles, as well as their many ordinary uses in the kitchen.

In certain parts of the year the fruits of these vegetables are met with in the markets in large quantities and at consequent low prices, while at other seasons they cannot be found at all. This irregularity of supply is due to methods of raising them, and to the fact that cucurbitaceous plants are not grown in all seasons. Farmers grow these vegetables by letting them trail over fences, the roofs of houses, and over flat-topped trellises. When grown in caiñgins (mountain plantations), the same place is planted over and over again with the same kind of plant and the vines are allowed to creep in the thickets or in the unutilized grassy places. No cultivation is given them and insects and fungus diseases are allowed their own way. The farmers do not even prune the tips or control the trailing of the plant. However, in spite of this neglect, a reasonable yield is often obtained from the crop. After harvesting the fruits, they are taken directly to the market in a *carreton*, a kind of ox cart, or in baskets placed either on horseback or carried by men on their shoulders, or by women on their heads.

SOIL

No fundamental differences in soil and in treatment are demanded by different species of the cucurbitaceous family of plants, except, perhaps, the melon, which requires much care and a fine texture of soil. It is said that, as garden crops, cucurbitaceous vegetables demand soil which easily responds to climatic conditions as well as to fertilizers. To keep it mellow the soil intended for these plants should be plowed deeply and thoroughly prepared before planting. A well prepared soil promotes a vigorous growth in the plants. When the soil is in good condition, it allows good drainage; there is no baking or cementing of particles which prevents the roots from penetrating easily; and the evaporation of moisture is checked. Moreover, fertilizers easily become available if applied to soil in this condition.

REMARKS ON TRELLIS

The use of trellis for the cucurbitaceous vegetables economizes in space of ground occupied by them.

The flat-topped trellis is the most common type used by the growers in the Philippines.

In some localities it was observed that a large flat-topped trellis covering a space of about 200 square meters of surface was occupied by only 2 or 3 vines with a yield ranging from 20 to 50 fruits a vine.

An *upo* (1) grown in Orion on a flat-topped trellis occupying about 200 square meters of ground produced about 100 fruits to one plant. This yield was unusual. My culture of 18 plants of the same variety on a vertical trellis occupying 182 square meters of ground yielded 204 fruits. Comparing the two, the average yield per plant with vertical trellis is very much less, but as the number of plants in the same area is greater the fruits per unit of area are about twice as many as with the flat-topped trellis.

Another case compared was a flat-topped trellis in San Antonio occupying 55 square meters of surface on which three vines of *ampalaya* grew. The total yield was 50 fruits. In my culture on the College farm, 27 vines on three vertical trellises occupying 50 square meters yielded 198 fruits.

From the above comparisons one may conclude that as trellises allow more plants to be planted on a space of ground, the yield per unit of area may be several times greater than when the flat-topped trellises are used.

CULTIVATION

The ground to be planted with cucurbitaceous plants is prepared with hand implements when the field is small, or with a plow, if the plantation be large. In either case, the following purposes of preparation should be kept in mind:

1. To produce uniform depth and texture in the field.
2. To add humus to the soil by plowing under green crops and other vegetable matter.
3. Prevention of the growth of weeds, which rob the plants of a large amount of food.
4. Conserving moisture in the soil. A well prepared soil usually keeps up a surface mulch which delays the evaporation of water.
5. Prevention of soil washing and erosion.

The first plowing should be at least 20 cm. deep.

The Philippine method of preparing the ground intended for watermelons and related vegetables is to plow the ground lengthwise to a depth of not less than 20 cm. and then harrow it. Four or five days later, it is plowed and harrowed crosswise. After this is done, the regular planting is made. When the seedlings have 4 or 5 leaves, cultivation follows till the vines are long enough to cover the interrows.

In gardens where plows are not much used the spading fork is the best tool for soil preparation and tillage. After turning the soil four times and manuring heavily, it is ready for the planting of the seedlings of cucumbers and related vegetables, and a frequent raking will serve for subsequent tillage.

NURSERY WORK

The cucurbitaceous vegetables, although among the easiest of vegetables to propagate, are very susceptible to the attacks of their enemies. It is one of the objects of nursery work to give the plants a good start. In order to do

this successfully some points in the location of a good nursery should be borne in mind.

A nursery should have rich soil and should be well protected, but not in deep shade. The grower must see that the seedlings are stocky and vigorous.

There are three ways of starting the plants successfully.

1. By direct planting of the seeds in the permanent place. In planting of this kind, it is assumed that the soil has been recently and thoroughly prepared. Rows should be 180 to 360 cm. apart, the hills, 60 to 180 cm. apart in the row; the planting, 3 to 4 seeds in a hill.

2. By planting in flats (see Plate I) or seed boxes. A box, 40 cm. by 25 cm. by 8 cm., is filled with 3 layers of 3 distinct types of soil. The lowest layer is dried leaves and coarse soil, thus allowing ready drainage. The middle layer is fine, sifted, well-rotted compost or humus which is especially rich in organic matter. This layer must be firm and well watered to establish capillarity. The seeds are planted in this layer and pressed down hard enough to come in contact with the soil. The thin top layer is very fine sifted sand. The purpose of this fine sifted sand is to destroy the capillarity and evaporation of water from the box, since with this arrangement the moisture rises up to the seeds only. The box is kept in medium darkness to attain a high percentage of germination. When the seeds have germinated, the box should be carried to the sunlight for a certain length of time to accustom the seedlings to resist the heat of the sunshine and at the same time to encourage a stocky growth.

Watering should be done every day, in the afternoon if possible. The plants are ready to be transplanted to the permanent field when they have from 4 to 5 leaves.

3. Planting of seeds in inverted sod in a hot bed, as practiced in cool countries, as America, for example.

The inverted sod as described by Lloyd is a strip of thin soft wood 45 cm. long and 8 cm. wide. This is folded squarely 10 cm. each side. Each one is filled with a finely sifted compost and the strips are put side by side in flats, one against the other (9).

In this country, where growers do not take the trouble to prepare "inverted sod," a bamboo with a cavity of from 5 to 8 cm. in diameter is cut into tubes 8 cm. long and put in the flats in the same way as the "inverted sod." Bamboo tubes of this kind (See Plate 1I) are called *"tukil."* The *tukil* is filled with soil the same as flats. Two or three seeds are planted in each *tukil.* When seedlings have developed 4 or 5 leaves, they are ready to be transplanted to the field.

Direct planting of seeds in the permanent place, from the standpoint of labor, has the advantage. The grower does not have the work of the preparation of the flats and *tukil,* or the transplanting of the seedlings. But seedlings raised this way are more exposed to the attacks of their enemies.

INSECT PESTS

Cucurbitaceous plants in all their stages of growth are very susceptible to the attack of insects. It is difficult to find a planting where insects have not caused considerable destruction. Any part of the plant, the stem, the leaf of the flower, the fruit, is liable to insect injury.

The insect pests which came under the writer's observation are here described, together with such remedies as were used.

Ants: A certain variety of small black ant attacked the cucurbitaceous seeds in flats. This ant did not attack

the seeds immediately after they were planted but waited until the seed coats or testa opened to allow the passage of the embryo. Then they entered and ate all the seed contents.

As a preventive remedy, powdered naphthalene was applied on top of the soil in which the seeds were planted. If seeds are planted in seed boxes or flats, the latter may be placed on a table-like frame, the legs of which are put in small tin cans filled with water, or each leg of the table may be wrapped with pieces of rags dipped in kerosene. Any one of these methods keeps ants away from the seed boxes.

After the young seedlings have come out of the ground they are no longer subject to the attack of ants.

Cutworm: Cutworms attacked the stems of cucurbitaceous plants by boring into them, or cutting them entirely through. Young seedlings, as well as older plants, are subject to the attack of this enemy. It was observed that newly transplanted plants are especially susceptible.

Yellow beetle: (*Aulacophora coffeae* Hornst.) Like the cutworm, the yellow beetle attacks both young and old plants. However, instead of attacking the stem, it attacks the leaves, and eats the soft parts, leaving only the skeleton. Ashes, or Paris green mixed with lime in the proportion of one part Paris green to thirty parts lime by weight were found effective remedies. The former was always applied in a dry form, while the latter may be applied in either dry form or in solution. The remedy should be applied as soon as new leaves are formed.

Squash-Vine Borers: Many times vigorous-growing squashes wilted and died without any manifestation of outside injury. This was caused by squash-vine borers.

Remedies: Early trap plantings were made to attract the borers. After the borers had settled in the holes in the plants, they were either burned or plowed under, deep enough to kill the larvae and destroy the eggs at the same time. After this, the soil was supposed to be free from the borers and the next and actual planting would be safe. Another way of combating this enemy is to force the plants to produce roots at their joints by hilling; this makes the plants more vigorous and better able to resist the pest.

Melon Lice: The melon lice are small, rapidly multiplying insects of a blackish green color. These lice attacked the cucumber, the melon and related plants. They pierced the surface of the leaves with their beaks and sucked out the juice. Plants attacked by this kind of insects were easily detected. The leaves ordinarily curl, turn yellow, and lose turgidity. Another sign of the presence of the insects in the plants is the presence of ants. That is, when ants are present on the leaves in abundance we can be almost sure that melon lice are present also.

A control measure must be employed at the earliest possible time. At the College the most common method used is to destroy the insects by the application of kerosene emulsion. This emulsion is prepared as follows: One half pound of soap is dissolved by heating it in one gallon of water in a tin vessel. When the soap is entirely dissolved, and while the solution is hot, two gallons of kerosene are added, little by little, to the soap solution until both liquids are thoroughly mixed together (15 minutes' stirring with a pump is enough.) This is the stock solution and should be a perfect emulsion. The safest and most economical proportion of this solution used for spraying cucumber and related plants is one part of the

stock solution to thirty parts of water. The solution when well and carefully used has proved to be almost 100% efficient.

In the Michigan Experiment Station the following method of combating melon lice is practiced: "To place a low tent over the plants and to fumigate with burning tobacco stems and other agents. Such fumigation has given partial success but seemingly is little, if at all superior to the sprays"(2).

Leptoglossus membranaceous Fabr.: The *Leptoglossus*, a sucking insect, called *atangya* in Tagalog, feeds especially upon the *ampalaya* and the related plants and accompanies the cucurbit flies in destroying the fruits. The *Leptoglossus* thrusts its beak into the fruits where it feeds and the flies lay eggs in the holes thus made.

Cucurbit flies: (*Dacus cucurbitae* Coq.) The cucurbit flies attack the fruits only. They insert their ovipositors into wounds on the fruit and lay their eggs there. As soon as the eggs hatch, the larvae feed upon the internal portion of the fruits and this ordinarily results in complete rotting.

This insect was bred and the following record was obtained:

On July 29, 1915, some larvae were collected from rotted fruits.

On August 1, 1915, larvae had gone under ground (pupated).

On August 7, 1915, emergence of flies took place.

On August 9, to 14, 1915, copulated.

On August 18, 1915, eggs hatched and larvae began feeding.

MATERIAL STUDIED

(See Plate VI)

The present study covers seven distinct genera of Cucurbitaceæ. They are the following, with their respective College numbers:

4268 *Benincasa cerifera* Savi.—Kondol or Malinga

4400 *Cucumis sativus* Linn.—var. Tagalog

4262 *Cucumis sativus* Linn. var. Tagalog

2462 *Cucumis sativus* Linn.—Var. Intsik

4258 *Cucurbita maxima* Duchesne—Calabasa from Orion

4266 *Cucurbita maxima* Duchesne—Calabasa from College campus

5849 *Cucurbita maxima* Duchesne—Calabasa

5850 *Cucurbita maxima* Duchesne—Calabasa

5851 *Cucurbita maxima* Duchesne—Calabasa

5852 *Cucurbita maxima* Duchesne—Calabasa

5853 *Cucurbita maxima* Duchesne—Calabasa

5854 *Cucurbita maxima* Duchesne—Calabasa

5855 *Cucurbita maxima* Duchesne—Calabasa

4256 *Lagenaria vulgaris* Ser.—Upo or Tabayag from Orion

4267 *Lagenaria vulgaris* Ser.—Upo or Tabayag from College campus

5848 *Lagenaria vulgaris* Ser.—Long White Upo or Tabayag from San Antonio

1389 F2 *Luffa acutangula* Roxb.—Patolang Tagalog

5595 *Luffa acutangula* Roxb.—Straight long Patolang Tagalog

4554 *Luffa cylindrica* Room.—Patolang Castila

4438 *Momordica charantia* Linn.—Ampalaya, long white var.

4341 *Trichosanthes anguina* Linn.—Snake or serpent gourd (Eng.), Pacupis (Tagalog)

BENINCASA CERIFERA SAVI.

Kondol

The *kondol* is the single species under the genus *Benincasa*. It resembles more or less the pumpkin, although the *kondol*

has a waxy fruit while the latter has not. The *kondol* has been cultivated in China since the remotest times. Several authorities claim that it has never been found wild. Cogniaux claims that it is synonymous with *Cucurbita hispida* Thunberg, and *Lagenaria dasystemon* Miquel, and that these plants are found wild in Japan. "Rumphius has seen it cultivated in Malabar and the Sunda Islands"(3)

In Guam, this plant is called *kandot* or *candol*; it is *kondol* in Tagalog, *calabasa blanca* in Spanish; and ashy pumpkin in Ceylon. (1)

Bailey describes the plant as follows: *Benincasa cerifera:*—Wax gourd, includes the Chinese preserving melon, Chinese watermelon. (4)

"Annual; vines long, like muskmelon, hairy, with cordate, lobed, triangular leaves; fruits mostly oblong, 25 cm. to 40 cm. long, hairy waxy, with solid white flesh and small, cucumber-like seeds. Cultivated the same as muskmelon or cucumber." (4)

It may be added that the male flowers have a long stalk and the female flowers are almost stalkless and are yellow in color. (1)

In India, where the planting season is almost the same as in the Philippines, the *kondol* is planted in the yards and allowed to climb on the roofs of houses, where it serves also as an ornamental.

In the Philippines the natives do not fertilize their cucurbitaceous plants, neither do they practice seed selection. They are satisfied with yields as low as 2 or 3 fruits per plant. Too much area is used for a few plants,—two plants are usually given a space of about 100 square meters.

In a barrio of Calamba, cultures of *malinga* or *kondol* were found. The average yield per plant was 8 fruits. Each plant occupied a space of about 25 square meters and the average price of the fruit in this locality is ₱0.20 each.

In Bantan, a barrio of Orion, some cultures were found yielding on an average 5 fruits per plant. Each plant occupied 15 square meters of ground. The price in this locality is ₱0.25 to ₱0.30 a fruit.

Uses: In Queensland, the fruits of this vegetable are used as a vegetable as well as for preserves. (5) In India and Ceylon they are used as vegetables in curries. (6) In the Philippines some natives cook the young fruits with meat or salted fish, while others make confections out of the mature fruits.

CULTURE

Of two plantings the first, May 24, 1915, was killed by heavy rain; the record of the harvest of the second, on September 30, is shown in the following table:

College Number and Variety Name	*Date of Planting*	*Date of Harvesting*	*No. of Vines*	*No. of Fruits*	*Weight of Fruits in Kg.*	*Area in Sq. M.*
4268 Kondol	Sept. 30, 1915	May 3-31, 1915	18	45	168.75	50

The yield was somewhat reduced because of a severe storm while the vines were on the trellis. The vines yielded an average of 2½ fruits each; with an average weight of 3.75 kilos for each fruit. Each vine occupied on the average 2 7/9 square meters of ground.

CUCUMIS SATIVUS LINN

Cucumber

The cucumber is an annual climbing plant having a rather pubescent and angular stem. The tendrils are 4 to 15 cm. long, single toothed, and are borne in the axils of the leaves. The

leaves are more or less ovate, cordate, 4½ cm. to 13 cm. long and 5 to 16 cm. broad. They are decidedly pubescent, 5-lobed, each lobe containing a main vein. The flowers are axillary and solitary. Both the male and female flowers are yellow in color, bell-shaped, and with short peduncle, the latter being 0.05 to 1.0 cm. in length. The fruits, which are of various forms, are commonly cylindrical and pubescent when young, the spine-like structures disappearing when they are mature. Usually they are yellow in color and tuberculate. (7)

In America, (8) where much attention is given to raising this vegetable, L. C. Corbett describes four important ways of growing cucumbers, two of which might possibly be applied in the Philippines; the other two are applicable only in cool countries.

The former two methods are:

1. Growing for early market in the open.

2. Growing for early pickling purposes.

The direct planting of seeds in the field at various distances, as in rows 120 cm. to 180 cm. apart and from 60 to 180 cm. apart in the row, is commonly practiced. Beans are intercropped with cucumbers to the great advantage of the latter. The beans protect the cucumber from the excessive heat of the sun and from the strong winds, besides benefiting it by the nitrogen fixed in the soil by the root tubercles.

An ordinary crop for the market is 200 half-barrel baskets per acre and the price varies from $0.50 to $2.00 a basket. After harvesting, the vines are either burned or plowed under to destroy the breeding place of insect diseases.

An ordinary pickle cucumber crop produces from 3 to 9 tons per acre, and the usual price is $15.00 per ton. The usual gross return to the farmer is ₱100.00 to ₱120.00 per acre. The chief expense in raising this crop is the harvesting. A farmer offers one-half the crop after it has been grown as payment for the work of harvesting, yet, even such conditions are not eagerly accepted.

Results of an experiment with cucumbers at the Michigan State Agricultural College Experiment Station are given below:

Names of Varieties	*No. of Hills*	*Season*	*Total No. of Fruits*	*Yield per Acre in Bu.*
Early Short Green	4	From	507	245.38
Early Cluster	3	August	310	200.06
Early Russian	4	14, 1905	392	189.86
Earliest of All	3	to Sept.	290	187.14
Pickling	4	11,	379	183.43
Early White Spine	3	1905	192	123.77

The above table gives us material for comparison with the yields obtained in the Philippines.

CULTURE

The data of the two plantings of cucumber are given in the table below:

College Number and Variety Name	*Date of Planting*	*Date of Harvesting*	*No. of Vines*	*No. of Fruits*	*Wt. of Fruits in Kg.*	*Area in Sq. Meters*
4262 Chinese cucumber	May 21, 1915	Aug. 20, 1915	72	115	54.63	100
4440 Tagalog cucumber	June 17, 1915	Aug. 31, 1915	36	132	58.14	50

Forty to fifty per cent of the fruits of the Chinese cucumber and ten to twenty per cent of the Tagalog were destroyed or rotted before harvest. They were not included in the record.

LAGENARIA VULGARIS SER.

Upo or Tabayag (T.) Tabuñgao (Il.)

The *upo*, or *tabayag* is a rather coarse annual trailing vine. The stems are angular and hairy, feeling velvety to the touch. The tendrils, have the same clothing as the stems and are axillary and two-branched or in rare cases three-branched. The length of the tendrils varies from 24 to 38 cm. The leaves are ovate to orbicular-cordate (7) with a velvety surface. The length ranges from 14 to 26 cm. and the width from 19 to 36 cm. The lobes are 3 in number, but in some leaves they can hardly be detected. The flowers, more or less the same size as those of the *kondol*, are white in color, bell-shaped, and solitary, with a cylindrical peduncle. The male flowers have their peduncles 8.5 to 15 cm. in length. The stamens are three in number. The female flowers have their peduncle 7 to 10 cm. in length, stigmas 3 in number, style cylindrical and 0.7 cm. long, ovary varying in shape, commonly elongated or rounded, though some are oval. They are pubescent when young but the hairs gradually disappear as they grow older. The matured fruits vary from ½ to 1⅓ meters in length and from 8 to 12 cm. in diameter; they are of many different forms and serve many different purposes.

Linnaeus believed this species to be of American origin, while De Candolle was of the opinion that it was Indian. Roxburg and Rumphius considered it to be wild in India. Its distribution is very wide. It is grown on the coast of Malabar, in the humid forests of Dehra Dun, on the seashore in the Moluccas, in Fiji, and on the coast of Queensland, both in the wild and cultivated forms(3).

The Filipinos grow as a vegetable a variety which is known in America under the name "calabash."(10) The plants are planted and treated as the *patola*, except that with the so-called *upo*, more attention is given to fertilization.

In Orion, Bataan, where the raising of *upo* is far more extensive than that of any other related cucurbitaceous vegetable, many growers are in the habit of fertilizing the plants in a peculiar manner. The stem of the plant planted in the ground is enclosed with a cylinder made of bamboo, about 60 to 75 cm. in length and the same length in diameter. A large amount of well—rotted manure is put in the cylinder, making it one-half to three-fourths full. Daily watering aids the plant to get a food supply from the manure as it passes into the ground in a soluble conditon. It is the belief of most of the growers that plants manured in this way live longer and bear more fruits than do unmanured plants. The writer saw a case where a flat-topped trellis, as shown in Plate III, occupying about 200 square meters, was used for one plant only which had been treated and manured in the manner described above, and which yielded about 100 fruits, selling at an average price of ₱0.12 each in the local market, and at ₱0.30 to ₱0.35 each in Manila.

In Batangas about the same number of fruits was raised from one plant covering an area of 150 to 200 square meters. Filipinos believe that if the fruits are not allowed to mature on the vines the plants produce more fruits.

The fruits of the *upo* are insipid, but palatable when cooked with other vegeables or with meat or fish. The fruits are always harvested when young. When old and seasoned the shells become hard and uneatable. In Colombo, Ceylon, the natives use the hard covering of this gourd as vessels for collecting toddy. (6) They are used also as buoys for novices in swimming. The shells of the large variety are used

as reservoirs for water, while those of the small variety are used for stringed and wind instruments, such as the "sitar," and the "bin." The seeds yield a limpid medicinal oil, while the pulp and leaves of both wild and cultivated plants are purgative (11). Making pipes from the fruits of some varieties of this gourd is practiced in America (10).

On November 6, 1915, some seeds taken from San Antonio were planted directly in newly prepared ground. Within six days the seeds germinated with 40% germination. The newly produced plants suffered severely from the attack of insects. Ash was used to prevent the attack of yellow beetles and kerosene emulsion the attack of plant lice. When the plants were one foot high and about to trail on the ground, a trellis was built covering 40 square meters of surface. Some of the plants died and reduced the number to 18. The plants were placed near the base of an old dead tree where there was a large deposit of compost. For this reason no additional manure or compost was applied. On February 23, 1915, some staminate flowers appeared followed some days later by pistillate flowers. Most of the fruits in this planting did not suffer much from the attacks of insects. Many of the pistillate flowers developed into fruits although about 20% of the total fruits failed.

The table below shows results obtained from the two plantings of *upo*.

College Number and Variety Name	*Date of Planting*	*Date of Harvesting*	*No. of Vines*	*No. of Fruits*	*Wt. of Fruits in Kg.*	*Area in Sq. Meters*
4256 Upo, Long Green....	May 24, 1915	Oct. 9-21, 1915	13	3	6.20	56
5848 Upo, Long White....	Nov. 6, 1915	March 19 to May 8, 1916	18	204	387.60	182

The results obtained from the first culture are not a fair average of harvest because of the effects of a storm.

From the figures in the second line of the table, the yield per plant was computed to be 11 fruits, and these from 10 1/9 square meters of surface. The fruits were valued at 12½ centavos each.

LUFFA

Stamens 5: fruit cylindrical, 1. *Luffa cylindrica* Roem.

Stamens 2-3; fruits sharply ribbed. (7) 2. *Luffa acutangula Roxb.*

1. *Luffa acutangula* Roxb.

The Tagalogs call this *patolang tagalog*. It is a rather coarse annual vine. The stem is angular. The tendrils are rather coarse and angular, and are 24.5 to 30 cm. long. Unlike the tendrils of the cucumber, they are generally 4-toothed, although 3-toothed ones are sometimes encountered. The leaves are 12 to 16 cm. long and 16 to 20 cm. broad, pubescent, with an almost circular outline. Some are suborbiculate, ovate, base cordate, (7) lobed or hardly so with the lobes 5 to 7 in number.

The pistillate and staminate flowers are separate but are found on the same plant.

The staminate flower is axillary, having a pubescent and 5-angled peduncled raceme. The peduncle is 7 to 18 cm. long. The flower is yellow, 1.7 to 2.0 cm. in diameter. The stamens are 2 to 3 in number and 4 to 6 cm. long.

The pistillate flower is axillary also, with a cylindrical peduncle, solitary and yellow. The calyx lobe is lanceolate-acuminate.(7) The fruits are oblong-oblanceolate, 40 to 58 cm. long, and 5 to 7 cm. in diameter. Ten prominent ridges running longitudinally on the surface of the fruit are decidedly conspicuous.

The plants are widely cultivated in tropical and subtropical regions.

Clarke believes that the plant is indigenous in British India. Rheede saw the plant on the sandy soils of Malabar, where it is called *papengaya*(3) and *theeatocrooee* by the hillmen in India.(12) The fruits of this plant are very different from those of any other cucurbitaceous vegetables. The plant is widely cultivated in the Philippines.

This plant is propagated by seeds. It is commonly planted in the yards where fences or trees serve as trellises. In some localities, growers claim that a bamboo clump serves as an excellent trellis. Others use artificial trellises, even if natural ones are available. Many of the Philippine growers of this plant do not take into account the kind of soil in which it is planted, neither do they select seeds. The only type of trellis used is the flat-topped one, constructed from 150 to 210 cm. high. No regular arrangement in planting is followed. The seeds are planted in one or as many as 5 to 6 hills under one trellis; at other times the seeds are planted at several places around the edges of the trellis.

The trellis of the type mentioned above looks like a big table with at least four bamboo or wooden posts for legs made of woven bamboo splits supported below by horizontally laid bamboo beams.

The fruits when used as vegetables are gathered while they are young. The reticulate, fiber-like internal structure begins to develop as the fruits mature and they then become uneatable. Some growers of this vegetable determine the right age of a fruit by pressing it between the thumb and one of the fingers. If it is hard, fiber growth has already begun and it is no longer edible. Another way of determining the maturity is by careful observation in the change in color of the rind. It changes in color from fresh green to chestnut as the fruits grow old. Before these signs appear, the growers harvest the fruits for market. In the local markets the price of the fruits ranges from 2 to 5 centavos each, although in very rare cases, when scarce, they cost 7 to 10 centavos each.

Most of the natives claim that there is a superstition in connection with the growing of these plants. They say that if a long and large stick is used as a mean of making holes in the ground in planting the seeds, long and large fruits will be produced. In this they believe they have a way of insuring a good yield.

As regards the amount of yield obtained, it was found that in Maahas, a barrio of Los Baños, 4 plants occupying a flat-topped trellis 30 square meters in area produced 48 fruits during their lifetime. In this estimate those destroyed by insects or other enemies are not included. The fruits were sold at an average price of 4 centavos each.

In Egypt and Japan the plants are extensively grown, not as vegetables but for the reticulate fibrous skeleton.

The reticulated endoskeleton takes the place of sponges for bathing purposes. Hats are also made out of the same fiber-like structures. In the Philippines the patola is used for food; it is cooked with meat and used in making soup. Roxburg claims that when "peeled, boiled, and dressed with butter, pepper, and salt, it is only a little inferior to the green pea."(12) The fruits are the only useful parts of the plant.

CULTURE

Seeds planted for this culture were from San Antonio, a barrio of Los Baños. The seeds are already in the second generation in the College under the College number 1389 F_2.

On May 24, 1915, 50 seeds of this plant were planted in one of the flats in the College nursery. Within two days the seeds germinated with 42% germination. The same care was given to these *patola* plants while they were in the nursery as was given to the cucumber. Thirteen days after germination sixteen plants were transplanted to the field and spaced 1.5 x 1.5 meters. Soon after transplanting the seedlings were attacked by the yellow beetle and a few days later they were attacked by plant lice also. The plants were sprinkled with Paris green and lime and with fresh ashes and sprayed with kerosene emulsion. The frequency of application of these insecticides depended upon the appearance of insects. When the insects were numerous, Paris green was applied as often as the dust from the leaves disappeared and as often as new leaves were formed. In this particular case both insecticides were applied once a week. When the plants reached the length of 30 cm., two spades of well-rotted manure were applied in each hill. When the vines were about 40 cm. long and were beginning to creep on the ground, trellises were erected. (See Plate III).

The plants flowered August 18, 1915, with both pistillate and staminate flowers, although the former were few compared with the latter. While young, the fruits were attacked by both *Leptoglossus* and cucurbit flies and about 30% to 40% of the yield was lost.

On December 2, 1915, seeds of No. 5595, *patolang tagalog*, a long and straight variety obtained from San Antonio, were planted in one of the newly prepared flats in the nursery. The seeds germinated within five days with 60% germination and the seedlings were transplanted on December 22, 1915, or fifteen days after germination, in half of the acclimatization plot No. 37, which contains 25 square meters area.

Although the plants were watered and cultivated twice a week, they suffered much from drought. They suffered also from insect pests.

The plants flowered on February 7, 1916, but on account of the enemies above mentioned, they grew very slowly and consequently fruits were slow in developing.

No fruit was harvested.

On January 18, 1916, another flat was planted with the same variety. On January 23, 1916, seeds germinated with 65% germination. On February 4, 1916, the plants were transplanted in the acclimatization plot No. 62.

The plants flowered on March 22, 1916, and fruited March 28, 1916. From 36 plants occupying a 50-square meter plot only a few fruits were harvested, as may be noted from the following table.

The weights of the fruits which were harvested at their marketable stage are also recorded in the following table.

2. *Luffa cylindrica* Roem. *Luffa aegyptiaca* Mill.

Patolang castilla or Spanish Luffa.

This variety of patola has almost the same botanical characteristics as the angular *Luffa*. However, the tendrils of the former are 2 to 4-toothed, lobes more distinct, and serrately cuneate; male flowers larger and more like a disk; stamens 5 in number; fruits almost cylindrical, with no ridges on the surface.

H. F. MacMillan claims that it can be propagated by cuttings as well as by seeds(6).

As to uses, the two *Luffae* are alike. For food, more people prefer the Spanish *Luffa* as it is odorous and appetizing.

In Maahas one plant occupying 15 square meters yielded 20 fruits which were valued at 3½ centavos each. In Orion one plant occupying 15 square meters yielded 15 fruits valued at 5

centavos each. In Calamba three plants occupying 60 square meters yielded 49 fruits valued at 4 centavos each.

SECOND CULTURE

Some seeds of *patolang castila*, 4545, *Luffa cylindrica* Roem, were secured from Maahas, a barrio of Los Baños. The seeds were planted June 22, 1915, in acclimatization plot No. 35. On the 5th day from planting the seeds germinated. Out of the 100 seeds, 40 germinated. Great care was given to these plants, for they were directly planted in their permanent place. Insects attacked them at their earliest stage and only 36 plants were left.

When the vines reached a length of about 30 cm., three vertical trellises were built. At first the vines did not seem to be disposed to use the trellis, creeping on the ground instead, but they were forced to trail on the trellis by tying them loosely.

On September 4, 1915, staminate flowers were produced. Five days later some pistillate flowers were also seen. At this time destructive insects were seen flying from one plant to another.

In October, when these plants were full-bearing, the trellises were blown down by a typhoon. They were put up again and the plants continued to bear fruits although the injury to the plants was evident. Another storm came and again the trellises were blown down. This time the plants were greatly injured. One hundred and fifty-six fruits were destroyed. Not long after the storm the plants died.

Some seed raised from the previous culture of 4554, *patolang castila*, were planted in a newly prepared flat in the nursery on January 12, 1916. Four days later the seeds germinated with 78% germination.

Stocky seedlings were transplanted on one of the acclimatization plots at a distance of 1 by 1 meter.

The early attacks of both sucking and biting insects were again noticed. The drought added much to the injury, causing the leaves to curl and delaying the growth.

The plants flowered on March 20, 1916, and 5 days later, fruits were produced.

The harvest record is shown in the following table:

College Number and Variety Name	*Date of Planting*	*Date of Harvesting*	*No. o Vines*	*No. of Fruits*	*Wt. of Fruits in Kg.*	*Area in Sq. Meters*
1389F_2 Patolang Tagalog...	May 24, 1915	Sept. 15-Oct. 14, 1915	15	133	44.8	25
5595 Patolang Tagalog....	Jan.. 18, 1915	April 29-May 11, 1916	36	36	19.62	50
4554 Patolang Castila.....	June 22, 1915	Sept. 28-Nov. 11, 1915	36	422	250.246	50
454F_1 Patolang Castila.....	Jan. 12, 1916	May 3-11, 1916	22	4	0.88	50

Patolang tagalog yielded 5 fruits as an average number, with an average weight of 0.36 kilos and with an average local value of ₱0.04 each.

Patolang castila yielded 12 fruits as an average number, with an average weight of 0.593 kilos and at an average price of ₱0.055 each. Among the Filipinos there is a greater demand for the *patolang castila* than for *patolang Tagalog*. The yield of *patolang castila* in the second culture was very low and was not included in taking the average yield per plant.

MOMORDICA CHARANTIA LINN.

Ampalaya

Like other cucurbitaceous vines, *Momordica charantia* is rather slender. The stem is hairy, angular, with 5 ridges. The tendrils are axillary with the same structure as the stem except that there are 4 ridges. They are single-toothed and 12 to 20 cm. long. The leaves are deeply serrated and distinctly lobed; 6 to 8 cm. long and 8 to 13 cm. in the longest diameter, pubescent and usually 3-lobed. The male flowers sometimes grow in the same axil with the female. The former are solitary, pale yellow, and 3.3 cm. in diameter and 3.4 to 5 cm. long; calyx pubescent, bell-shaped; stamens 3; peduncle rounded, pubescent, 1.5 to 2.0 cm. long to the metamorphosed leaf-like structure or "bractele." The female flower is 1.5 to 2.0 cm. long, cylindrical, solitary; stigmas 4 in number, ovary elongate, warty, both ends tapering to a point; taste bitter.

The same treatment that was given to *upo* and *patola* was given to this culture. The Filipinos never let the *ampalaya* creep on the ground because the fruits easily decay when in contact with the soil. The plant is very resistant to drought. It grows well in rich, but does not dislike rocky soil (13.) The plant has a distinct name in each of the different countries where it is cultivated. In India it is called *paveda;* in China, *fou-tchoo* (13); *couhoo* or *kariwala*, by Singhalese; *pekal* or *pavakay*, by Tamil; *margose* by French; *amargoso* by Spanish (5); *balsam apple*, in Porto Rico (14); and *ampalaya*, in the Philippines. The name *margose*, which is a form of amargoso, means bitter, for the plant as a whole is bitter.

Jenkin stated that there were two varieties of *ampalaya* at Patna; namely, Jethuya and Bara maisya.

1. Jethuya grows under the heat of the sun in the spring and dies at the first rain.

2. Bara masiya grows throughout the year. This variety of *ampalaya* is grown by the hillmen in the warm valleys in India at the beginning of the rains. It is made to trail on the ground. (2)

The wild variety of ampalaya growing in the Philippines is called by the natives *ampalayang ligao.* It is never planted nor cultivated but is, nevertheless, very prolific. The cultivated varieties are the long, white and slightly sweet *ampalaya*, the long green variety, and the *ampalayang pasig.* The *ampalayang pasig* is shorter and the tips are more blunt. The wild variety, the *ampalayang ligao*, is more or less oblong in shape and 4 cm. to 6 cm. long; the color and the surface condition of the fruit are similar to the cultivated varieties.

Fruits of the wild variety are sold at the rate of 4 or 5 for one centavo.

The seeds of the cultivated variety are planted by the natives during the months from May to August, the rainy season. *Ampalaya* is cultivated in the same manner as the *upo* and *patola.*

In Orion, according to the estimate of some amapalaya growers, a plant produces on an average from 20 to 30 fruits when the vines creep over from 8 to 10 square meters of surface. At their marketable age, the fruits are picked and according to their sizes classified. The first class consists of fruits from 20 to 30 cm. long, which are sold for 5 or 6 centavos each. The second class ranges from 10 to 17 cm. long and sells for 3 or 4 centavos each. The third class includes fruits less than 10 cm. long, which are sold for 1 or ½ centavo each.

Uses. The fruits are used generally for salads and in curry with fish. In the

Philippines the leaves are used also in curry with fish or meat. The internal part of the ampalaya has a disagreeable taste and should be removed before using the fruit in foods. The tender leaves and shoots are also used as food (6).

As medicine, the *ampalaya* has different uses in different regions. In the West Indies the fruit, which is bitter, is sometimes used as a remedy for malaria. The juice extracted by pressure from the terminal shoots and young leaves is also used for medicine. In India the plant is used as an external remedy for leprosy and malignant ulcers (2). The juice extracted from the shoots or young leaves is commonly used as a purgative for a newly born child in the Philippines.

CULTURE

The results of the only successful culture of *ampalaya* are given in the following table.

College Number and Variety Name	*Date of Planting*	*Date of Harvesting*	*No. of Vines*	*No. of Fruits*	*Wt. of Fruits in Kg.*	*Area in Sq. Meters*
4438 Ampalaya, Long White.	July 3, 1915	Sept. 10-Oct. 30, 1915	27	198	40.56	50

According to the above table, 7⅓ fruits was the average yield per plant while 240 grams was the average weight of each fruit. The average per fruit was 0.037. The area occupied per vine was 2 square meters.

TRICHOSANTHES ANGUINA LINN.

Snake or Serpent Gourd (Eng.)
Pacupis (Tag.)

The snake gourd is an annual, slender, quick growing, herbaceous vine. The stem is similar to that of *patola* (*Luffa*) in texture and coarseness. It is also angular. The tendrils are axillary and are two-toothed. The leaves are almost circular in form and from 12 to 18 cm. long, "undulated of waxy." Male flowers, racemose, the peduncle 10 to 25 cm. long, bearing 8 to 15 flowers; brackets either absent or present, and large or small; calyx tubular, 5-toothed, pubescent, green in color; corolla deeply tubular, fringed, fringes 1 to 2 cm. long; stamens 3; anthers connate (7). The female flower has the same general appearance as the male, but is solitary; peduncle cylindrical, ½ to 1 cm. long, calyx and corolla same as the male; ovary one-celled; style slender, the stigma 3 to 6 cleft, fruits globose-ovoid or elongate, smooth, often more than 90 cm. in length (15). About 40 species of *Trichosanthes* are found in India, Japan and Southwest Australia; 3 or 4 are found in the Philippines.

In Réunion the plant thrives at about 600 meters above sea level. It is planted at the beginning of autumn and it dies at the end of winter (18). Like the cucumber, this plant should be supplied with plenty of moisture. During summer when drought is long it is profitable to the plants.

The Indians are fond of growing snake gourd. In places inhabited by Indian emigrants, one may find plantations of this plant alone. Trellises of the flat form of 15 to 25 square meters, raised 2 to 3 meters high above the ground are used. In each of the intersections or angles a bundle of sticks or twigs is placed as a provision to lead the plants from the ground to the trellis as well as to support and protect them from destructive animals.

The manner of planting is the same as that for other cucurbitaceous plants. The Filipinos make holes from 15 to 30 cm. in diameter and in depth. They then half-fill the holes with well-rotted

manure or compost mixed thoroughly. Some plant the seeds without manuring the holes until the flowering time when they apply about one kilo of manure or compost to each hill.

In India, where the plants are planted near houses, they are supplied with all sorts of organic matter. When the plants reach the trellis their tips are pinched off to force the production of lateral branches where growth of fruits commences. Three months from planting the plants begin to fruit. The fruits are of various shapes and sizes. Some planters use devices to mold the fruits to different forms. To force a fruit to become straight a stone, of weight proportional to the size of the fruit, is hung by a piece of string at its extreme end. The fruit must hang in a straight and vertical position and the stone be changed to a larger one as the fruit grows in size (13).

In the Philippine Islands but few know this plant and its uses.

Uses: The delicate flavor and semi-seedless pulp of the immature fruits render the snake gourd a first-class salad vegetable. "Peeled and cooked, then divided into strips, it excels string beans." (16) The Indians and the Negroes divide the fruits into small pieces and treat them the same as peas. This is done when the fruits are young; when mature the outer portion of the fruit is removed and the remainder used as above (13). Cameron states that the fruits are sliced and dressed and eaten like French beans (12).

CULTURE

Seeds of this plant were obtained from the Department of Agronomy. They came from the cultures of the Agronomy-Special Class.

Some of these seeds were planted on May 21, 1915, in nursery "tukils" which were prepared for the purpose. (A "tukil" is a bamboo tube.) Three days later the seeds germinated with 73.8% germination. The same treatment was given to the gourd seedlings as was given to those of the related plants. On May 31, 1915, in one corner of the Agronomy Special's garden, 32 seedlings were transplanted. A week later the plants were attacked by cut-worms, plant lice, and the yellow beetle. The cut-worm did the worst damage and only 5 plants were left. Replanting could not be made, for the material was very limited. Application of kerosene emulsion and Paris green helped matters very much. A week after transplanting application of well-rotted manure was made at the rate of 2 shovels per hill.

As soon as the plant began to creep on the ground a vertical trellis was constructed.

By June 26, 1915, the plants were flowering. Three days later the plants were adorned with a great number of staminate flowers which made the plants conspicuous even at a long distance.

On July 1, 1915, pistillate flowers were noticed. These were few at first but soon increased in number as rapidly as did the staminate. Only a small percentage of the flowers failed to develop. The fruits were attacked by *Leptoglossus*. Although some of them decayed, yet many matured. The fruits were harvested before reaching maturity except those which were intended for seeds.

The heaviest yielder gave 53 marketable fruits while the lowest yielding plant gave 6 fruits. The latter, however, was partly injured by the cultivator. The fruits, as the Filipinos are not familiar with them, were distributed to encourage them to cultivate the plant.

On August 24, 1915, some seeds were again planted in the same manner as the above, in flats in the College nursery

Within 3 days the seeds germinated with 85% germination. On July 6, 1915, the seedlings were transplanted to the acclimatization plot No. 28. Fifteen days later the plants were badly attacked by plant lice. Three or four applications of kerosene emulsion stopped the attacks. By November 15, 1915, the plants were flowering and 5 days later fruiting was also observed.

Three typhoons severely injured the plants so that only a few fruits were harvested.

College Number and Variety Name	*Date of Planting*	*Date of Harvesting*	*No. of Vines*	*No. of Fruits*	*Wt. of Fruits in Kg.*	*Area in Sq. Meters*
4341 Pacupis.....	May 21, 1915	July 19-Oct 8, 1915	5	199	47.5	12
4341F_1 Pacupis.....	Aug. 2, 1915	Dec. 21, 1915	3	8	3.5	50

The above table shows that the average yield per plant was 39 4-5 fruits, on an average space of 2.4 square meters. The average weight of one fruit was 239 grams or 0.239 kilogram.

CUCURBITA MAXIMA LINN.

Squash

The natives of the Philippines claim that this plant is biennial or even triennial.

The stem is angular, with 5 ridges. The tendrils, which have the same texture and clothing as the stem, are axillary and 15 to 17 cm. long. They are 3 or 4 branched, and 15 to 39 cm. long. The leaves are kidney-shaped, base cordate, pubescent, commonly spotted on the surface with various forms and sizes of pale spots, 14 to 20 cm. long and 14 to 25 cm. in longest diameter, the lobes not distinctly divided, three in number; flowers solitary, large, yellow in color, and shallowly lobed. The male flower has a cylindrical, pubescent peduncle, 4 to 6 cm. long; calyx cup-shaped, pubescent, green; corolla tubular at base, and flattened at top; stamens 3 in number. The female flower has an angular peduncle, 5 to 8 cm. in length; hairy; bracts, present in some varieties, are 5 in number and lanceolate in shape; sepals and petals same as in the male; stigmas 3 in number, forming an umbrella-like structure. Ovary of various sizes and shapes, some are cylindrical, some are rounded, some are bottle-shaped, some are spindle-shaped, others are heart-shaped, while others are flattened.

In 1604, Champlain claimed that it was found along the coast of the state of Maine interplanted by the natives with maize (20).

In 1855, the squash was hardly recognized. Sir Joseph Hooker believed that Barter found it to be indigenous on the bank of the Niger in Guinea. In Angola it was found cultivated by Welwitsch but it did not grow there wild. De Candolle claims that the plant has been long cultivated in Abyssinia, Egypt and other African countries. Linnaeus believed the species to be of American origin. Springer believes that it was found wild in the Himalayas (3).

Squashes and pumpkins are closely related plants and one can hardly be distinguished from the other. M. Naudin established the true distinctive characteristics of squashes and pumpkins. They are as follows:

The leaves of squashes have almost rounded lobes, smoother peduncle, and the lobes of the corolla turned outward. The pumpkin has leaves with pointed lobes and with a markedly ridged and furrowed petiole.

The corolla is narrowed at the base and the lobes are almost always upright (3).

The most common varieties of squashes are the winter squashes, which include Hubbard, yellow gourd, Spanish gourd, Marblehead, Sibleu, and Turben.

The squashes are extensively grown in the United States. The growers divide them into two distinct types, namely the summer and the winter types. These two types are distinguished as follows:

Summer: Harvested while in an immature state, for some varieties become coarse and bitter at maturity.

Grown in bush form.

Provided with hard covering to endure the heat of the sun.

Hard and condensed stems and vines, small fruited. More reliable crop produced under unfavorable conditions, such as under the shade of corn or under intense heat of the sun.

Winter: Harvested during the mature stage. Long vine variety.

Do not thrive in competition with corn.

Suffer in intense heat or drought.

Fresh and succulent vines.

Large fruited.

In England "vegetable marrows" take the place of the summer squashes in America. They have long running vines and are treated the same as squashes (9).

In the United States, where the growers practice selection and devote their efforts to intensive cultivation, and to combating destructive insects, the establishment of many different varieties has resulted. Some of the varieties are Mammoth Summer Crookneck, Straightneck, Early Yellow Bush Bush Scallop, White Bush Scallop, etc. These are the early varieties. Hubbard Squash is a good representative of the late varieties and is noted for its superior quality; it ripens well and keeps long (17).

The seeds of the squash are planted in the months of May and June and in November and December in the Philippines; during the rains in Northern India, where the fruits are ready by the cold season; in April on the hills in India and the plants mature in July (12). In Bengal they are planted in October and in Cuttack from February to March (11).

The Filipinos do not provide the squash with trellises as they do other species of this family. The plants are allowed to creep wherever they will. In this way the stems root at the nodes and the plants take up more food from the soil, and live longer and more fruits are produced. Besides this, gardeners practice other treatment to increase yield. One is splitting longitudinally the main stem 15 to 20 cm. from the roots, and inserting some object to prevent the union of the split parts when the wound heals. Sometimes the tip of the main stem is cut off, forcing it to send out many lateral branches. Still another is to remove some of the main roots, as the adventitious roots are enough to supply the plant with plant food.

In Vermont, experiments have been conducted in comparing the large-seeded with the small-seeded squash. The result has been tabulated as follows:

Size of Seeds	*No. of Seeds Planted*	*Wt. of Seeds Planted*	*No. of Vines*	*Total No. of Fruits*	*Total Wt. of Fruits in Lbs.*	*No. of Salable Fruits*	*Wt. of Salable Fruits in Lbs.*
Large seed	150	48.9	75	111	1330	110	1324
Small seed	150	23.1	75	112	1230	96	1158

In experiments with crossed varieties in New Jersey, it was found that the Midsummer Drought (bush variety) rarely matured more than two fruits to the plant; but a vine formed which is much better than the Midsummer Drought (as one plant of a cross) produced 54 fruits of marketable size and another "Angora" produced about a quarter of a ton of fruits (18).

In the Philippines no selection has been practiced and hence no special types has been established here. Although we do not have a winter here as in the temperate zone, yet there are times when the growers do not succeed in raising the squash. This is specially true during the long drought in summer. At present we have only one kind of squash, a long-vine variety, in the Philippines. It is more extensively planted during the rainy season than during the dry season. When the dry-season planting is made, wet season seeds are used, and as a result of this and other factors the yield is very much reduced.

Uses: The fruits are cooked with sugar or salt or with salted fish. In this country, where the pumpkin is not extensively grown, squashes take its place in pies and sweet preserves. In German East Africa the young leaves are cooked the same as spinach (11). In the Philippines, the tips are cooked with other vegetables or with meat, or salted fish.

In America, where the Mammoth Chili is the largest variety, the fruits are used as stock feed (19). In the Philippines they are used sometimes for the same purpose, but are cooked before fed to the stock. The seeds have a medicinal value due to the oil content.

CULTURE

Several plantings were made of the squash. The date of the different plantings are given in the table which follows:

College Number and Variety Name	*Date of Planting*	*Date of Harvesting*	*No. of Vines*	*No. of Fruits*	*Wt. of Fruits in Kg.*	*Area in Sq. Meters*
		First Culture				
5853 Calabasa	May 26, 1915	Oct. 2, 1915-Feb. 17, 1916	23	56	98.68	261
5852 Calabasa	May 26, 1915	Feb. 17, 1916	12	60	186.00	173
5854 Calabasa	May 26, 1915	Feb. 11, 1916	12	54	149.73	162
5849 Calabasa	May 26, 1915	Jan. 13-Feb. 17, 1916	3	27	88.88	144
5851 Calabasa	May 24, 1915	Feb. 17, 1916	8	34	95.60	216
5850 Calabasa	May 24, 1915	Jan. 18-Feb. 1, 1916	9	70	279.20	288
5855 Calabasa	May 21, 1915	Feb. 11-18, 1916	6	61	161.89	432
4266 Calabasa	May 24, 1915	Aug. 7, 1915-Jan. 1, 1916	6	65	264.18	196
4258 Calabasa	May 24, 1915	Oct. 11, 1915	5	16	48.51	112
5855		Jan. 18, 1915				
		Second Culture				
5854 Calabasa	Aug. 30, 1915	Feb. 25-May 3, 1916	6	11	51.20	50
5855 Calabasa	Aug. 30, 1915	April 15-May 29, 1916	6	15	83.96	50

From the first culture it was found that one vine of 5853 occupying 11.4 square meters produced an average number of 2½ fruits, with an average weight of 1.76 kilos per fruit. One vine of 5852 occupying 14.4 square meters produced an average number of 5 fruits, with an average weight of 3.1 kilos per fruit. One vine of 5954 occupying 13.5 square meters produced an average number of 4 fruits, with an average weight of 2.588 kilos per fruit. One

vine of 5849 occupying 41.33 square meters produced an average number of 9 fruits, with an average weight of 3.29 kilos per fruit. One vine of 5851 occupying 32 square meters produced an average number of 7 7/9 fruits, with an average weight of 3.987 kilos per fruit. One vine of 4266 occupying 32⅔ square meters produced an average number of 10⅔ fruits, with an average weight of 4.064 kilos per fruit. One vine of 5855 occupying 75 square meters produced an average number of 10½ fruits, with an average weight of 2.65 kilos per fruit. One vine of 4258 occupying 22 2/5 square meters produced an average number of 3 1-5 fruits, with an average weight of 3.03 kilos per fruit.

In the second culture it was found that one vine of 5854 occupying 8⅓ square meters produced an average number of 11 5/6 fruits, with an average weight of 4.65 kilos per fruit. One vine of 5855 occupying 16⅓ square meters produced 5 fruits, with an average weight of 5.596 kilos per fruit.

In computing the number of fruits on the 100 square-meter basis it was found that 5852 gave the highest yield, (35 fruits), and 5855 and 4258 gave the lowest yield, (14 fruits).

The varieties covered in this study vary in the shape of the fruits as follows:

4266 is a rounded but compressed type, having depressions deep and shallow, alternately running from tip to butt of the fruit. Most of the fruits came true to type in shape and color. But there were some elongated ones of a different color, having also deep and shallow depressions. Still others were oblong with shallow depressions but of the same color as the parent. Some forms intermediate between those above mentioned were also observed.

5849 is an elongated type. It is almost cylindrical with shallow furrows. Fruits from this were also of various shapes. Some were compressed and differing much from the present except in color and markings. Some were like the parent fruits, but very much larger. Some were spindle-shaped. Others were ill-formed fruits in which characters of the parent could hardly be traced.

Of all the types observed, the above two made the widest variation from the parent.

5852 is a spindle-shaped type, having shallow depressions. No great variation in shape was shown by the fruits it produced. The shape varies from oblong to heart-shaped. Color and markings are also variable.

4258 produced fruits which were almost uniform in shape although there were some which resembled a top in shape.

5850, 5853, 5851 are all elongated types. They produced fruits almost similar to the parent.

5855 and 5854 are compressed types. The fruits they produced were somewhat similar to those of the parent.

The progenies of the last 5 types differ from their parents not so much in shape as in markings and color. But there were fruits produced which were not similar in any respect to those of the parent. This seems to show that seed selection would be of little value, unless means were constantly employed to control pollination.

ACCLIMATIZATION

Foreign varieties of cucumber, pumpkins, and squashes should be acclimatized in the Philippines for the following purposes:

1. To increase the variety of Philippine vegetables.
2. To produce heavy bearers of large fruits, and bearers of fruits of fine quality.

3. To produce bush varieties which demand only a small area of ground.

Materials used for this purpose came from J. M. Thorburn and from the Germain Seed and Plant Co., Los Angeles, California.

These were more carefully handled than the native varieties, which were already adapted to the locality.

Seasonal tests have been carried on with these foreign varieties of pumpkins, cucumbers and squashes.

Although some varieties of squashes, such as Fordhook, Long Vegetable Marrow, Boston Marrow, and Delicater, and some of pumpkins, such as Mammoth Tour and Ey Sigar, did not even germinate, yet a large number of cucumbers, pumpkins, and squashes showed their vigorous standing before they died. Some died from attack of insects; and some probably because of the unfavorable climatic conditions, particularly a typhoon. It is the belief of the writer that if these varieties had been planted at the right season of the year success would have resulted.

More detailed results on some of these are as follows:

4641 Lemon or Garden Lemon Cucumber—two hundred and sixteen fruits were harvested April 12, 1916 and weighe 11.232 kilos.

4654 Improved Long Golden Cucumber—two fruits were harvested April 25, 1916, and weighed 0.51 kilo. These fruits are seedless.

4575 Large Kentucky Cheese Pumpkin—one fruit was harvested May 3, 1916, and weighed 1.9 kilos.

4854 Quaker Pie Pumpkin — Four fruits were harvested April 26, 1916, and weighed 1.02 kilos.

4573 Early Sugar Pumpkin—two fruits were harvested April 26, 1916, and weighed 1.43 kilos.

4579 Quaker Pie Pumpkin—one fruit was harvested June 22, 1916, and weighed 3.9 kilos.

4846 Winter Crookneck Squash—four fruits were harvested April 24, 1916, and weighed 0.50 kilo.

4658 Delicious Squash—one fruit was harvested June 26, 1916, and weighed 0.75 kilos.

4845 Summer Crookneck Squash—Four fruits were harvested April 24, 1916, and weighed 1.37 kilos.

SUMMARY

1. Cucurbitaceous vegetables are not economically or sufficiently extensively grown in the Philippines.

2. Ants, cutworms, melon lice, yellow beetles, *Leptoglossus*, squashvine borers, and cucurbit flies are the greatest enemies of the cucurbitaceous vegetables from the seedling to the fruits.

3. There are some preventive and effective remedies for the above mentioned enemies; namely, powdered naphthalene, early or late planting, contact poisons (kerosene emulsion), stomach poisons (Paris green mixed with lime), etc.

4. The differences in behavior of plants in the different seasons is marked. During the wet season, the plants grow faster and suffer less from the attacks of insects than in the dry season. Pollen-transmitting insects seem to be more numerous during the wet season, hence the yield is greater.

5. In this particular region, the period from May to August is by far the most favorable for the planting of cucurbitaceous vegetables.

6. A vertical trellis is very efficient in increasing production on comparatively small areas. Vertical trellises give a yield per unit of area two to three times greater than can be obtained from the ordinary type of flat-topped trellis.

7. Most of the imported varieties of squashes, pumpkins, cucumbers can be grown in the Islands.

RECOMMENDATIONS

1. The soil must be in good tilth, and should be heavily manured with well-rotted animal, as well as vegetable matter.

2. Seed should be selected under control and planted in the right season of the year.

3. Early application of both Paris green and kerosene emulsion must be made to prevent the attacks of both biting and sucking insects.

4. Vertical trellises should be used instead of flat-topped ones.

Acknowledgements are due Professor C. F. Baker, Professor of Agronomy, and Mr. Nemesio Mendiola, Assistant in Agronomy, for their valuable suggestions and advice in connection with the carrying out of this work.

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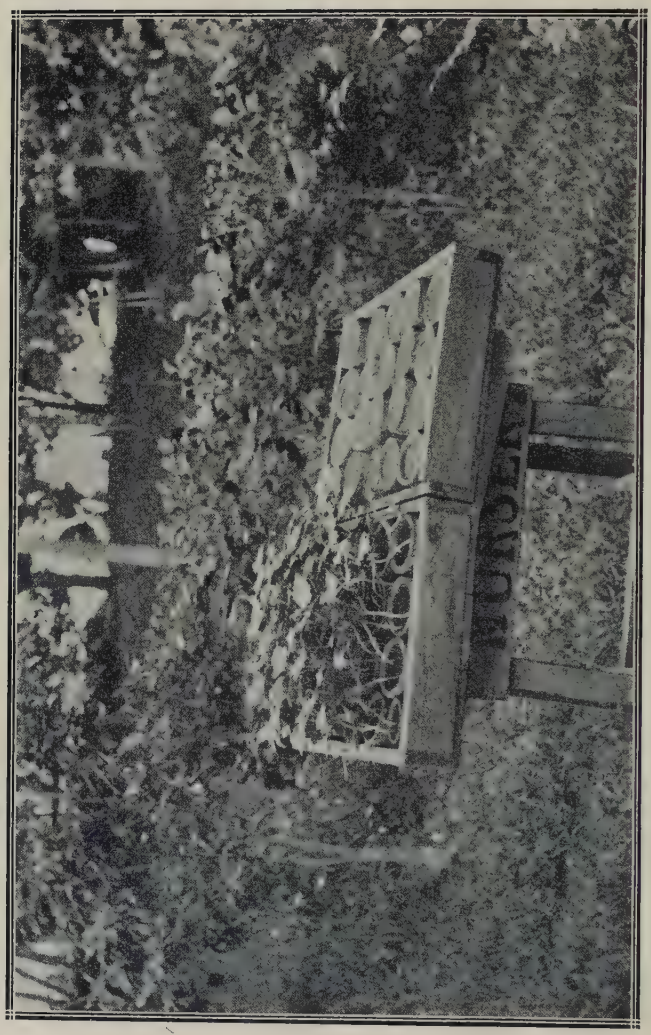
PLATE I

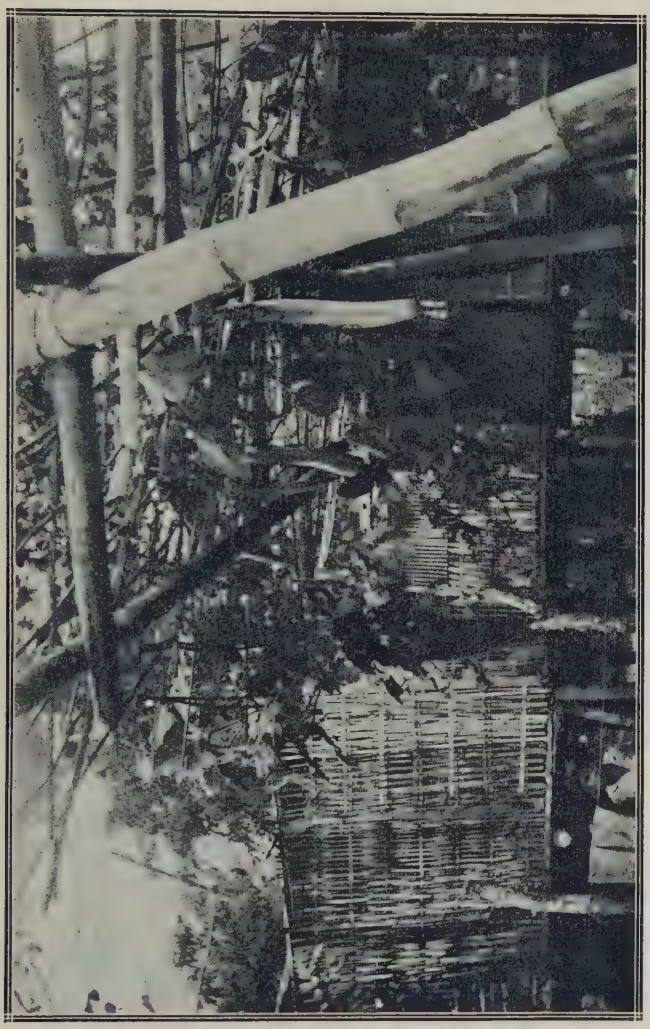
GERMINATING SEEDS IN ORDINARY NURSERY FLATS

PLATE II



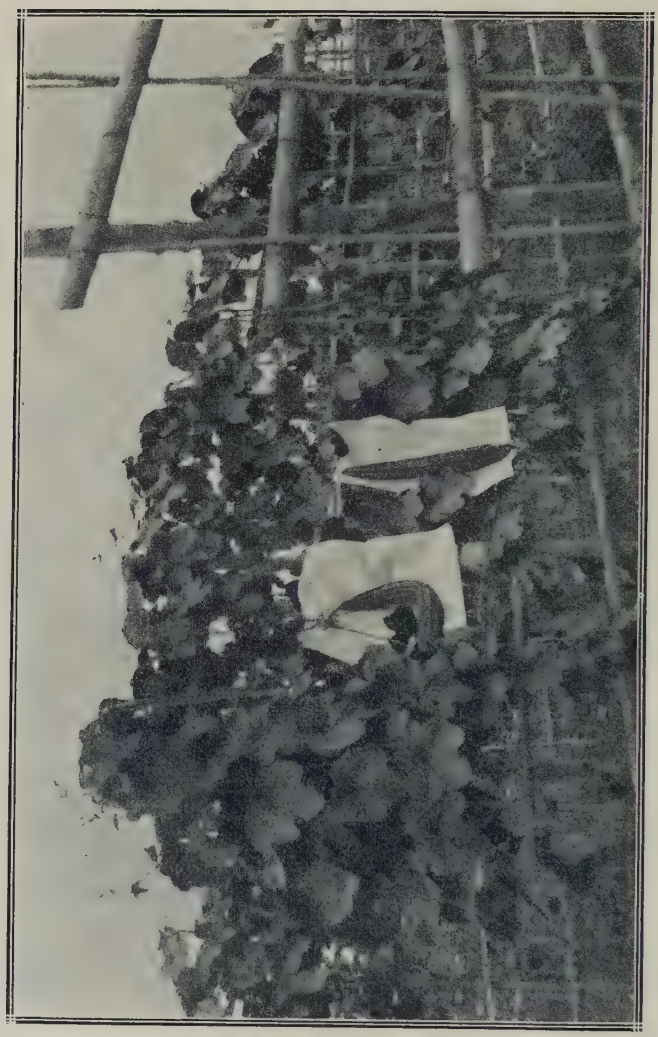
GERMINATING CUCURBITACEOUS VEGETABLE SEEDS IN "TUKIL"

PLATE III



LONG WHITE UPO ON FLAT-TOPPED TRELLIS

PLATE IV



PATOLANG TAGALOG ON VERTICAL TRELLIS

PLATE V

CALABASA TRAILING ON THE GROUND (COMMON METHOD OF GROWING CALABASA)

PLATE VI

FRUITS OF MOST OF THE DIFFERENT VARIETIES OF CUCURBITACEOUS VEGETABLES STUDIED

1. Large Kentucky Cheese Pumpkin
2. Quaker Pie Pumpkin
3. Summer Crookneck
4. Early Sugar Pumpkin
5. Lemon Cucumber
6. Improved Long Golden Cucumber
7. Winter Crookneck
8. Patolang Castila
9. Patolang Tagalog
10. Kondol
11. Calabasa

Diseases and Pests of Sugar Cane in the Philippines

The sugar cane is like every other principal crop of the Philippines in never having received a comprehensive study of its diseases and pests. It is further true that no one of the diseases or pests doing very considerable damage has as yet been the subject of careful investigation. Collections of insects and fungi made in past years by the Bureau of Science have included a number of the parasites of sugar cane, and, for a number of years, an effort has been made at the College of Agriculture to secure information as comprehensive as the facilities permitted on this subject. In this effort, taking into account both fungi and insects, Professor Baker has been the leader. The following statement of our present information on the subject is the result of a conference in which Professor Baker, Associate Professor Banks, Assistant Professor Reinking and Mr. Uichanco contributed information.

Of the fungous enemies of plants which are commonly spoken of as causing diseases, the following are at present known in the Philippines:

Puccinia Kuehnii (Krueg) Butl., the sugar cane rust. This attacks the leaves, and, while far from rare, is not known to do really serious damage here. It must, however, be regarded as of economic importance.

Ustilago Sacchari Rabh, the sugar cane smut. This attacks young canes and is occasionally found in cane fields, in which it is quite destructive. It may be controlled easily by burning all diseased shoots, and taking care in planting to use only healthy tips.

Bakerophoma Sacchari Diedicke. This fungus produces spots on the midrib and at the base of the blade of the leaf. Although first discovered a year or two ago, it is very common in this vicinity and is probably present in all sugar cane sections of the Islands. It lowers the vitality of the plant but does not destroy it.

Cercospora. There are several species of this genus on sugar cane in the Philippines. All produce leaf spots, which are commonly found in Laguna Province and all other sugar producing districts and countries. It lowers the vitality of the cane without killing it.

Phyllachora Sacchari Henn. is another fungus which does not seem at present to be of economic importance, but which, judging by the behavior of its relatives, might easily become so.

Meliola Arundinis Pat. is a fungous parasite of our cane which is unlikely ever to do damage of import.

Apiospora camtospora Penz. et Sacc. *Coniosporium extremorum* Syd. and *C. vinosum* (Berk. et Curt.) Sacc. are fungi commonly found on dead leaves of cane which may possibly encroach on living tissue, or have some connection with fungi starting on living leaves.

Of rind diseases, there are probably several. *Melanconium Sacchari* Cooke, which is the cause of the best known rind disease of canes elsewhere, is rather common here in poorly kept fields. Either close planting or lack of cultivation and consequent low vitality may result in the practical destruction of a crop by this fungus.

Of fungi attacking the roots, *Dyctyophora phalloidea* and a *Marasmius* are found here; both are recognized as enemies in Hawaii, and the latter is widely feared.

With regard to the fungous diseases of Philippine sugar cane in general, it may be stated that they do extensive damage, but that the extent of this is very largely due to the prevalence of exceedingly close planting of the cane and to the very general absence of proper cultivation. The effective-

ness of good cultivation in decreasing damage by these diseases is very well illustrated by the relative immunity of fields on the Calamba Sugar Estate, as compared with the many relatively uncultivated fields in the same neighborhood.

Before leaving the plant enemies of cane, it must be noted that we have also a flowering plant, one of the broomrapes, *Arginetia indica*, which is a root parasite on cane and some other grasses and was reported several years ago as doing appreciable destruction in a field near Santa Cruz, Laguna.

Turning now to the insect enemies of canes, we have pests attacking the stem, the leaf and the roots. Attacking the stem are the borers, which are stages in the life history of either beetles or moths. Among the beetles is a species of *Heteroncychus* related to or identical with borers destructive in Java and Hawaii. *Holotrichia vidua* Sharp is another species recognized as a serious enemy in Java as well as here. *Alissonotum pauper* Burm. is a beetle known only in the Philippines, but with destructive relatives elsewhere. We have also found the larvae of two genera of beetles, *Apogonia* and *Adoretus*, in newly opened furrows on sugar land on the College campus; so far, these have not been reported as attacking sugar cane in this country, but it is highly probable that they do so, as they are known to do elsewhere. Their attack is aimed at the roots, and they might easily be overlooked in the limited study given to cane pests here in the past.

Of the moths, *Diatarea striatalis* Zehnt, commonly called the Java cane borer and the most dangerous pest of this kind in Java, was discovered here only about a year ago but is now recognized as common. *Scirpophaga*, also found in Java, is another borer which does serious damage here in sugar cane tops.

Of the termites, or white ants, there are several species and these sometimes do serious mischief, particularly to newly planted cane.

Of pests attacking the leaves, the locusts are the most familiar and have longest been recognized. The abundance of waste land in the Philippines makes this particular pest more dangerous here than in sugar countries where the land is nearly all in cultivation, as is the case, for example, in Java.

Of cane hoppers, we have here *Perkinsiella vastatrix*, which is the commonest species here as well as the most abundant and destructive Javan species. There are also two endemic species of this genus found in cane here, *P. saccharivora* and *P. pseudosinensis*. *Prontista moesta* Westw. is common at times and always present in small numbers. It is not so dangerous in itself as because rusts and leaf spot diseases almost always accompany its attack. *Brixiodes carinata* is another hopper always present but in small numbers.

Tropidocephala saccharivorella is a Formosan leaf delphacid recently found here.

Oregma lanigera is a plant louse with the appearance of a mealy bug, which at times is very abundant and destructive in this vicinity, as well as in all other sugar regions in the Orient.

Dactylopiys sacchari is a scale insect found on the leaves, both here and in Java.

Spodoptera mauritia is a moth, the larvae of which feed on cane leaves here and in Java.

There are a number of other plant lice, beside those which have been mentioned, which have been found here on sugar cane but are not known to be destructive.

A root louse of the genus *Tetraneura* is occasionally very abundant on the roots of rice. Specimens sent to Java have been determined there as identical with a root louse which is there destructive to cane. It has just been observed that lice are abundant in the roots of sugar in a field near Calamba, and it is altogether likely that we have here a case of the same insect attacking both rice and cane.

Damage is also done to the roots of cane here and in other countries by some of the mole crickets. Beside insects, other animals which should be mentioned as enemies of cane are nematodes, of which two genera are known to attack sugar in Java but of which no determinations have been made here, although these worms are present. Damage is also done by rats, and, in individual fields, these seem to be the most destructive enemies of this crop. The damage certainly runs as high as 25 per cent.

It may be stated, in summary, that, except for a very few pests originally presumed to have lived on other plants and to have adapted themselves to sugar since its introduction as a crop in the American tropics, we have in the Philippines a large part of all the known serious pests of sugar cane and near relatives of the few which are not specifically known to be here. This is only natural in view of the facts that cane in an ancient cultivated crop in the Philippines, and that the common wild grass, *Saccharum spontaneum*, known in Tagalop as "talahib" and in Visayan as "tigbaw," is either the wild plant which has been developed into sugar cane by culture or, at any rate, a very near relative of cane, harboring the same pests and diseases.

The scientific questions as to the number and identity of pests are quite distinct from the practical question as to the damage done by these pests and diseases. On the latter point, Professor Baker, on the basis of experience in Cuba, and Professor Reinking, on the basis of personal acquaintance with Hawaiian conditions, both state positively that the damage done to cane by its pests and diseases in the Philippines is materially greater than that in other countries they know. While I have not visited typical cane country in Java, the impression I have gained from seeing cane in the western part of that island, and from talks with the governmental pathologists there, is that, in Java also, cane is raised with less destruction from its enemies than is the case here, although the number of known enemies is as great in Java and a large part of these enemies are identical here and there. Professor Baker, as agronomist, and Professor Reinking, as plant pathologist, are agreed also that the greater destruction to our sugar results not from the greater number of pests but almost altogether from close planting and from cultural methods which are poor in other respects. While open planting and good cultivation would not insure our crops against damage from insects to so great an extent as against the fungous diseases, the relief could still be expected to be very great, as it is found to be very great in Calamba, where good and poor culture can be directly compared.

The presence of very numerous enemies of cane in the Philippines being due to the facts that cane is old in cultivation and that it is perhaps, in its wild form, a native of these Islands, carries with it the further fact that the natural enemies or parasites of cane pests are also present here in great number and variety. These parasites on the parasites of cane hold the enemies of the cane in check, and, in a country like the Philippines, maintain

a sort of equilibrium. Because cane is an introduced plant of relatively recent culture in the Hawaiian Islands in the American tropics, there is in those countries the constant danger of the introduction and development of a pest of cane which will not be held in check to any appreciable extent by such parasites as the pest might find there. As a matter of experience, such pests are constantly presenting themselves and it is necessary to keep up a constant campaign of finding parasites of the cane pests, acclimatizing them and turning them loose to hold the cane pests in check. Because these parasites of the pests are abundant and various in the Philippines, the Hawaiian Sugar Planters' Association has found it worth while to keep at least one entomologist constantly on our College campus at Los Baños, for almost two years. The work of these entomologists has consisted in collecting, breeding, and shipping to Hawaii the insects which keep in check our local enemies of cane. It would be expedient for us also to import additional enemies of the pests of our cane fields, but such a campaign here is decidedly less necessary than in Hawaii because the number of natural checks on our cane pests is incomparably greater here.

To sum up:—The most of the recognized dangerous pests and diseases of sugar cane are present today in the Philippines. A larger percentage of damage is done to cane crops here by pests and diseases than is done in other prominent sugar producing countries. The greater damage done here is not because the pests are more numerous, but because of poor cultural treatment of cane; *such culture as is given cane in other and more prominent sugar countries may be expected to do away completely with the excess of damage now occurring here.* The antiquity of cane culture and the presence of wild sugar in the Philippines is responsible for the large number of pests and diseases found here, but at the same time is also responsible for the presence of parasites of the cane pests in the Philippines, and the presence of these natural checks on the excessive multiplication of the injurious insects is a fair guarantee that the injurious insects present here will not suddenly become epidemic as they have from time to time been observed to do elsewhere.

E. B. Copeland.

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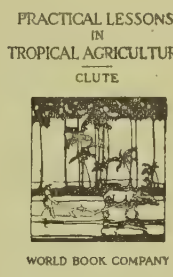

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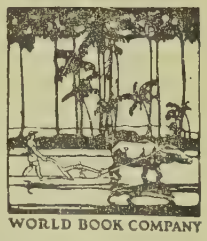

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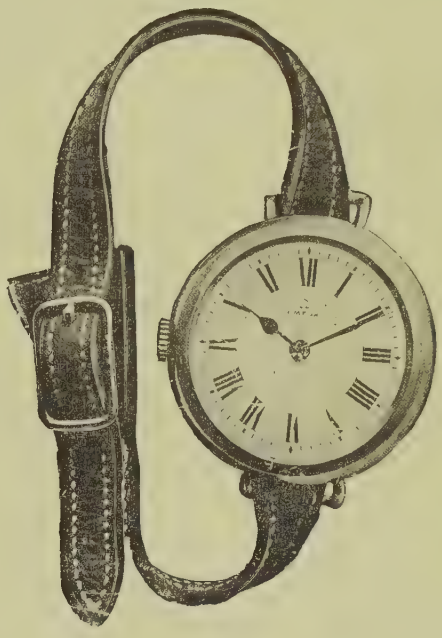

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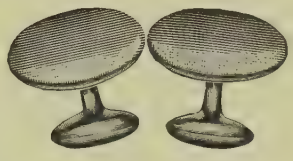

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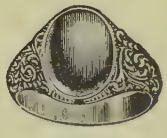

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